South African Carbon Stocks, Sources and Sinks

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CSIR
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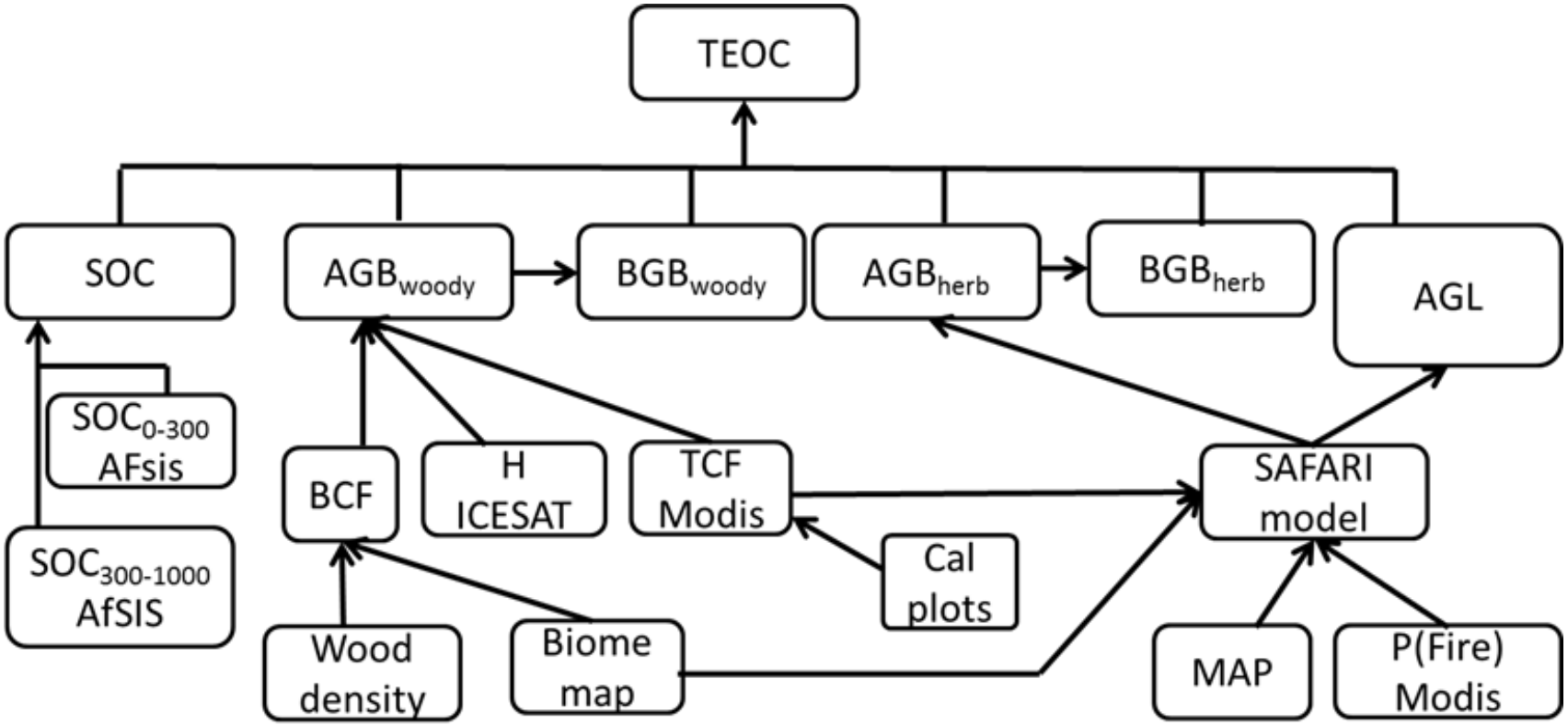
The SA Carbon sinks and fluxes project

- Commissioned by DEA as part of the Long Term Adaptation Strategy portfolio
- Funded by DFID UK
  - Task 1 Estimate the C stocks and fluxes
  - Task 2 Project how they might change
  - Task 3 Analyse the associated policies

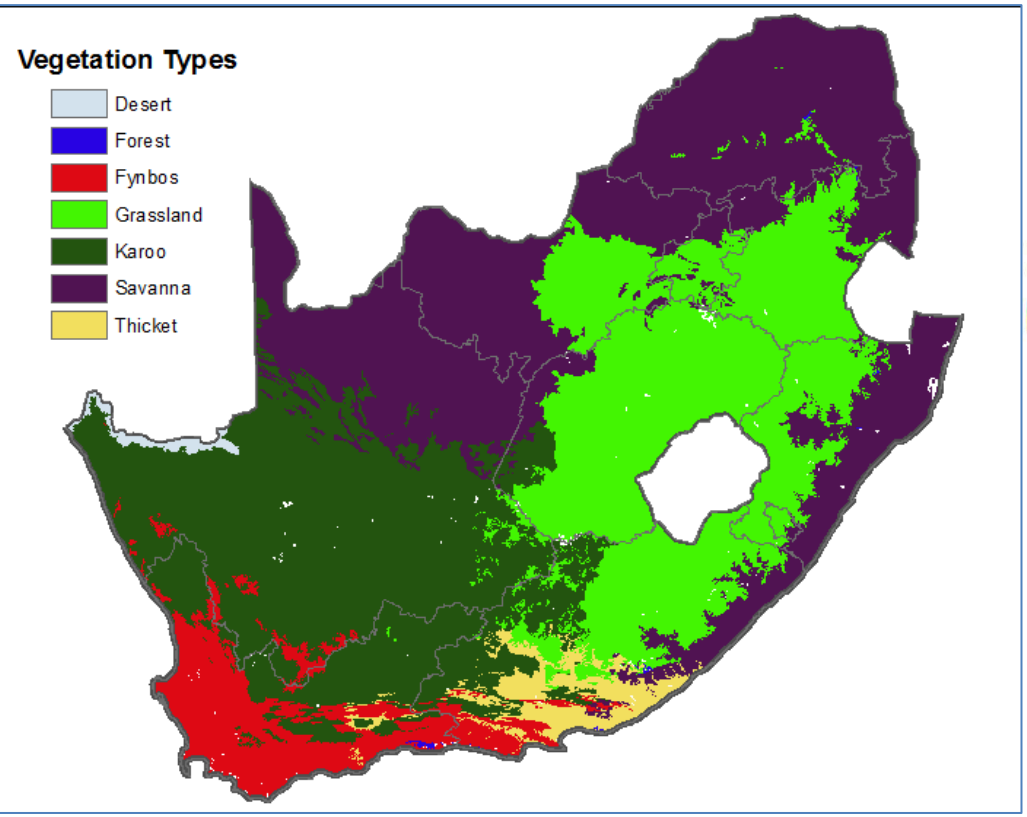
Comments on cost of estimation

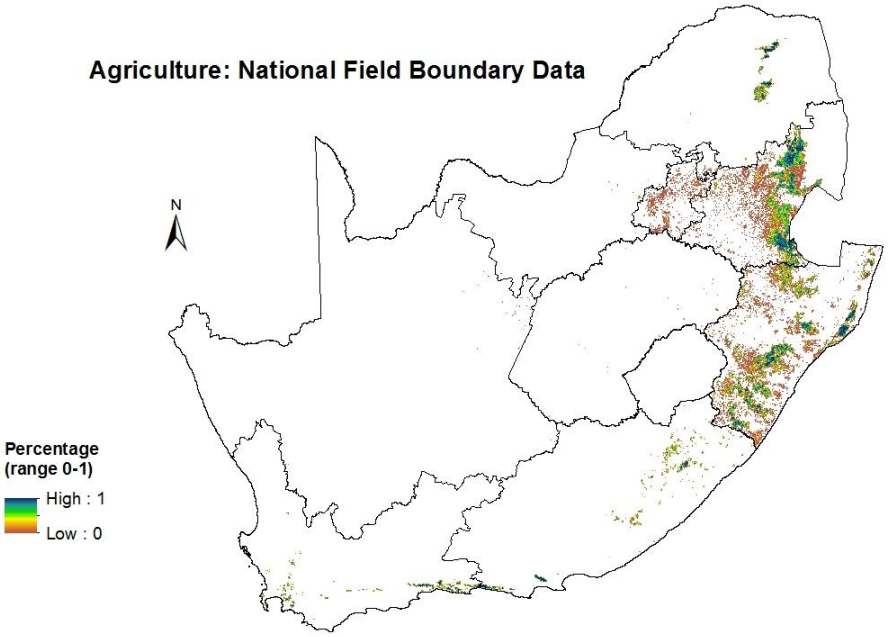
- The continuous-variable approach achieved a lower 90% CI (ie the conservative estimate) about 4% below the mean
- To have achieved this with a sampling approach would have required approximately 1000 samples nationwide
  - no subset with n<30 and error >10%
  - This would have cost about 3 times as much as the continuous variable approach.
- A sample-based approach, guided and optimised by the continuous variable approach, may be needed in future for change detection

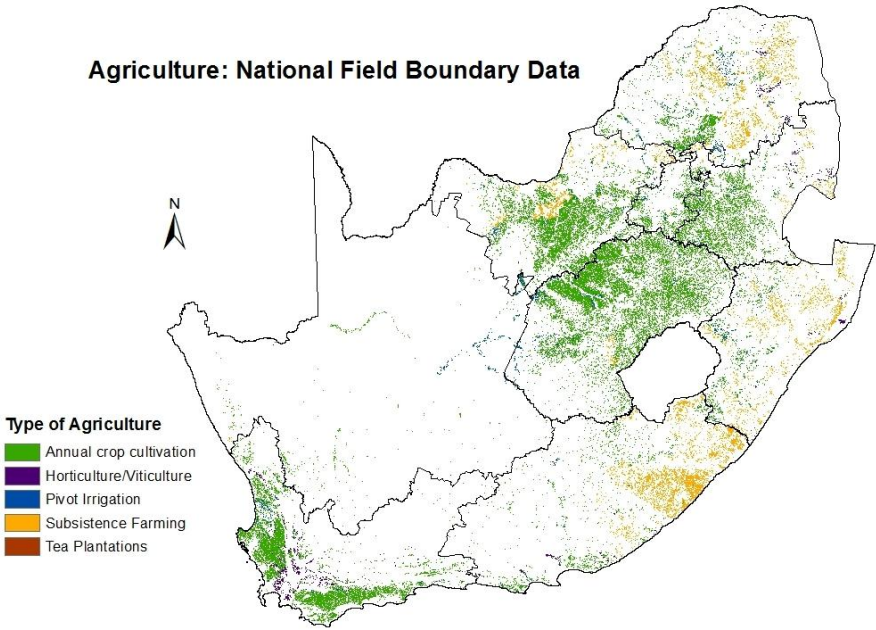
Components of the C stock



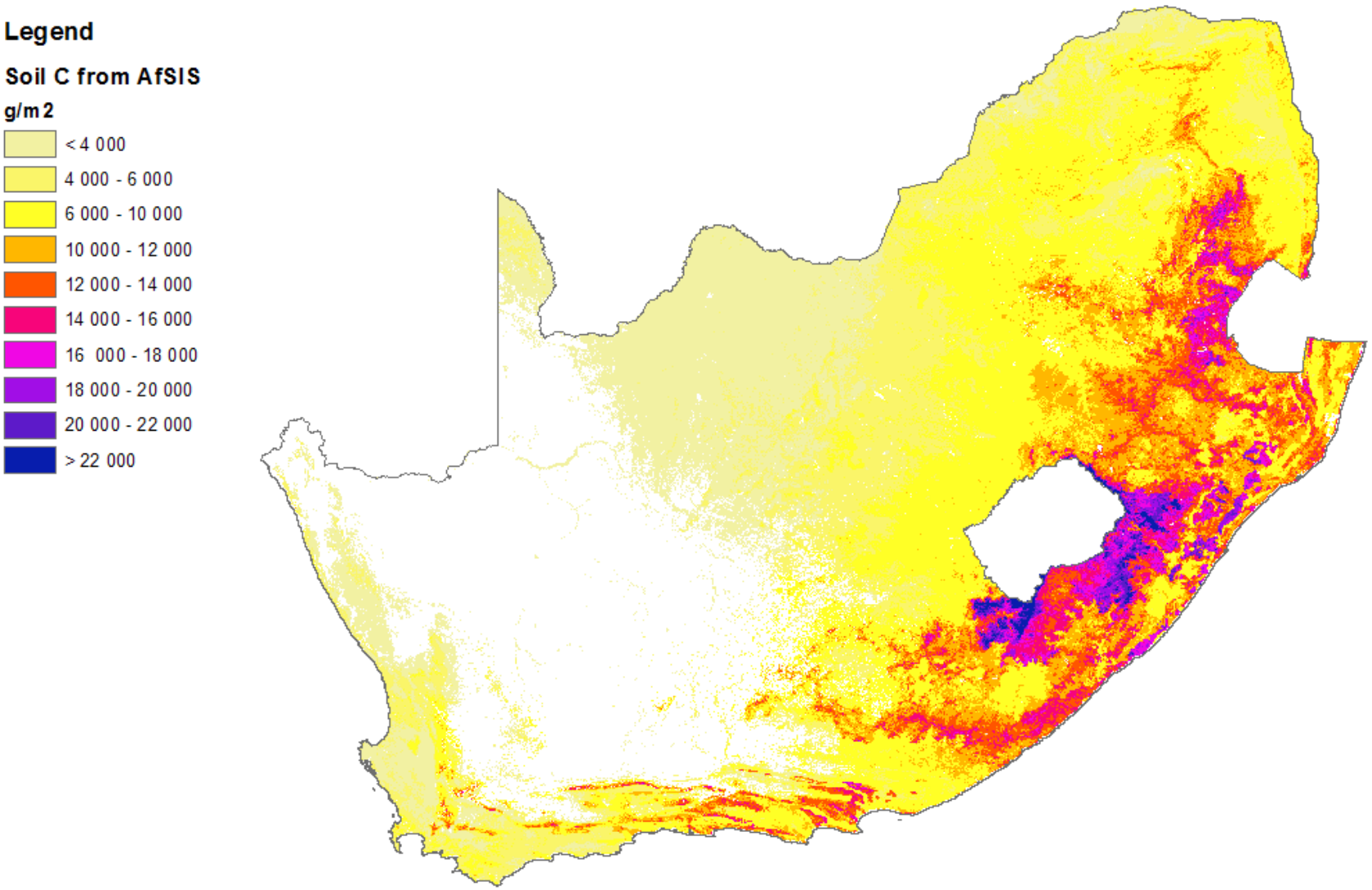
Input data – land cover



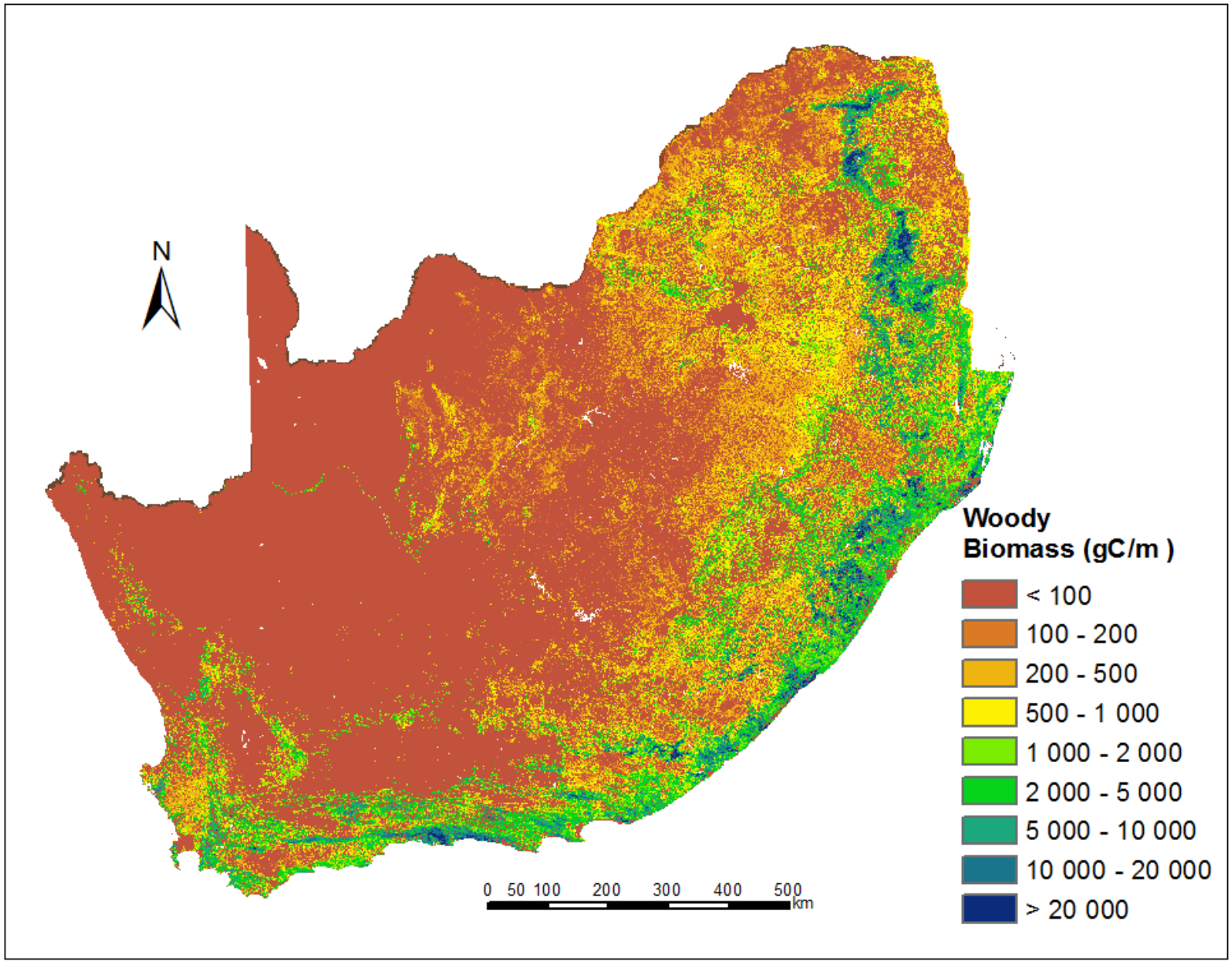




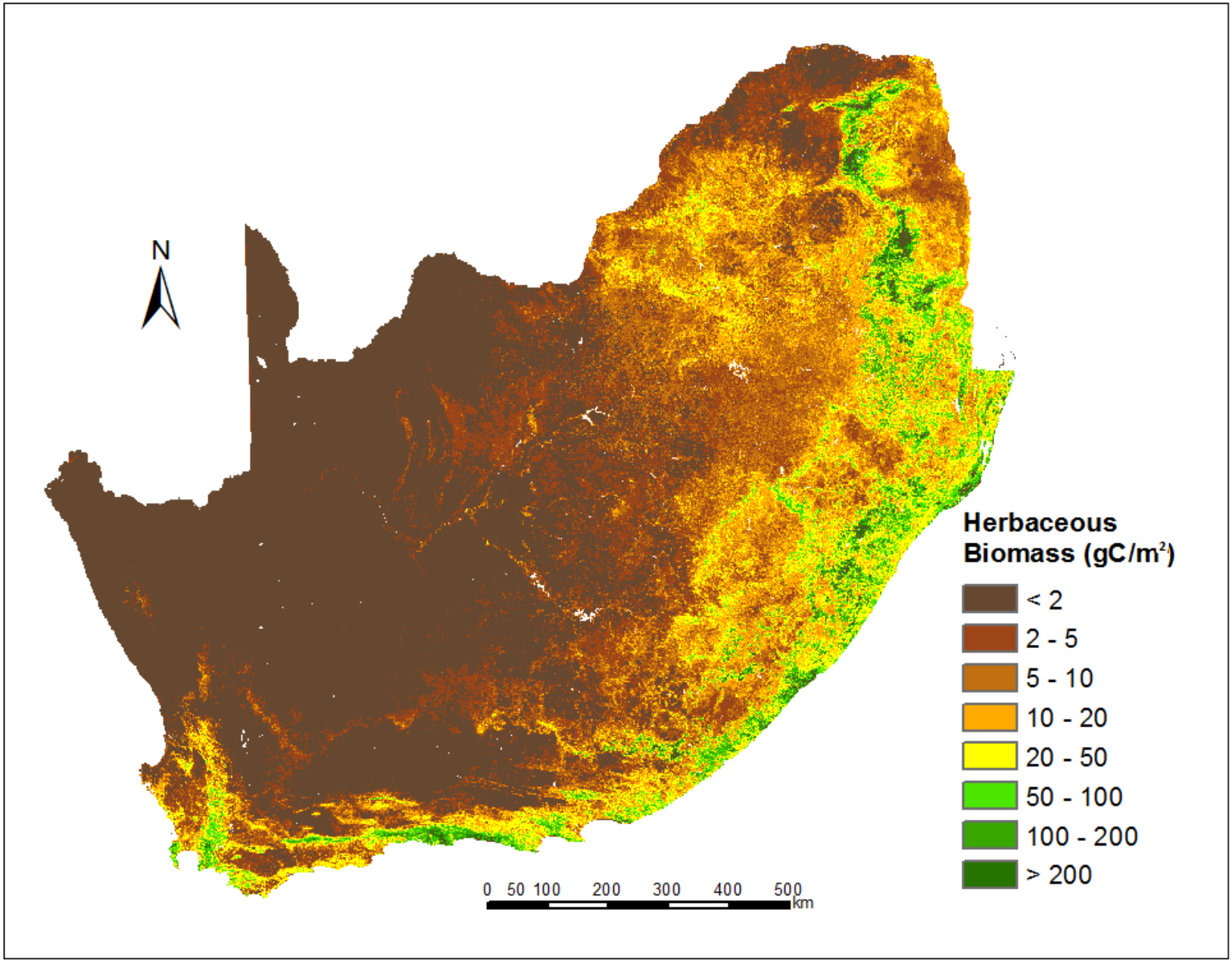
Soil Carbon - AfSIS



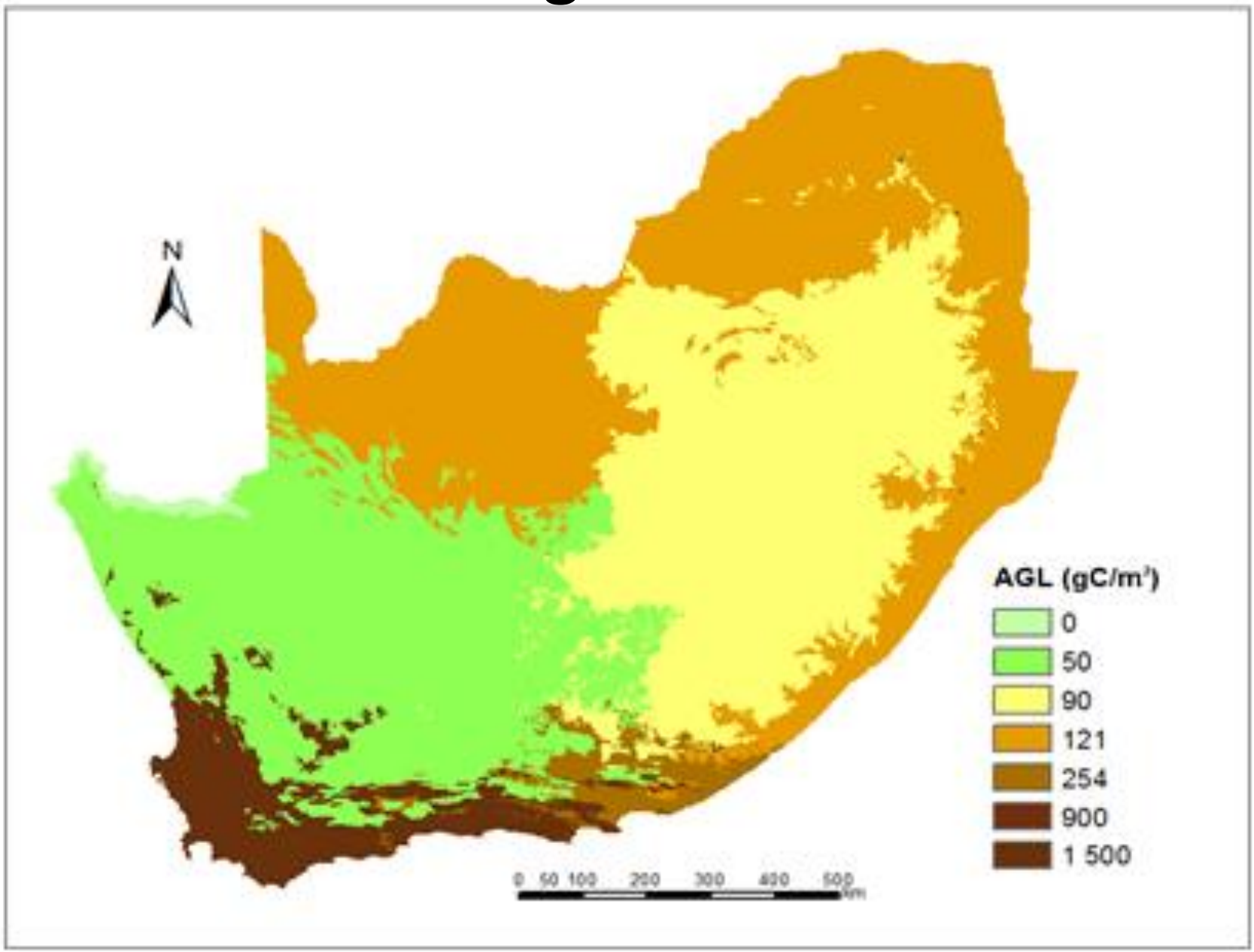
Aboveground woody biomass



Above-ground herbaceous biomass



Aboveground litter



Total Ecosystem organic C

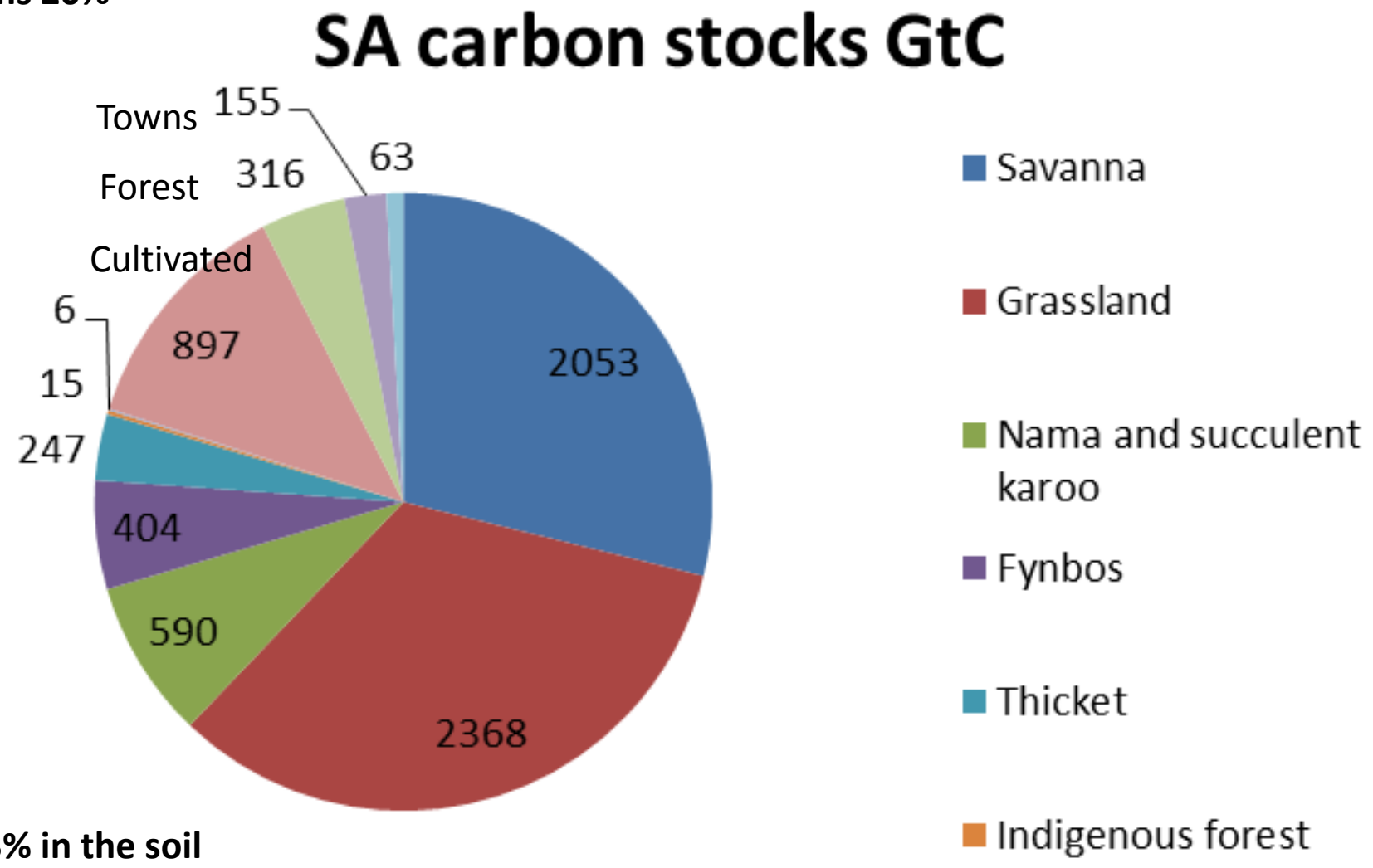
Land cover class	Mean	SD (spatial)	Area	Best estimate	Lower confidence limit	Upper confidence limit
	gC/m^2		km^2		Tg C	
Savanna	5834	3513	358473	2091	1961	5214
Grassland	10660	4725	224377	2392	2213	5736
Nama and succulent karoo	1769	1799	334812	593	587	862
Fynbos	6773	4100	61490	416	372	1140
Thicket	10101	5347	27402	277	236	785
Indigenous forest	18198	6172	857	16	12	42
Desert	799	113	7017	6	6	6
Cultivated	5980	1731	143948	860	840	1788
Plantation forestry	17559	4320	16952	298	252	769
Settlement, mines, industry	6793	2448	23119	157	152	276
Other, waterbodies etc	3167	1536	19967	64	62	97
Total South Africa			1218414	7170	6693	16715

Terrestrial Biomass Stocks

above– and belowground, plus litter

Land cover class	Mean	SD (spatial)	Area	Best estimate	Lower confidence limit	Upper confidence limit
	gC/m^2		km^2		Tg C	
Savanna	418	756	358473	150	123	342
Grassland	532	748	224377	119	109	279
Nama and succulent karoo	70	159	334812	24	30	54
Fynbos	1119	626	61490	69	51	140
Thicket	2370	3159	27402	65	41	152
Indigenous forest	7186	3423	857	6	3	13
Desert	1	17	7017	0	0	0
Cultivated	186	50	138269	26	41	56
Plantation forestry	4603	969	16952	78	56	148
Settlement, mines, industry	421	345	28798	12	12	19
Total South Africa			1169649	548	466	1203

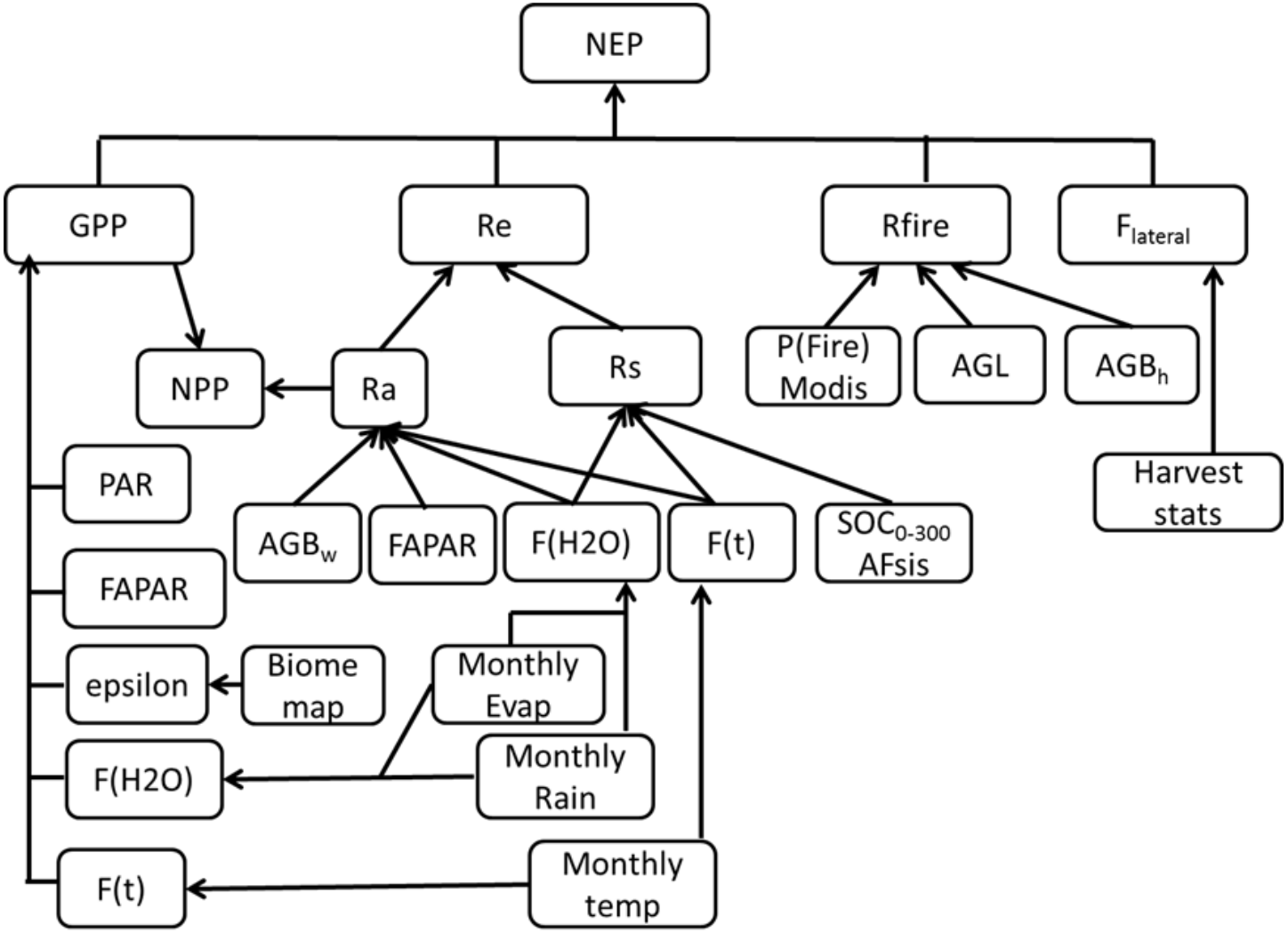
Transformed Systems 20%



93% in the soil

Natural systems 80%

Components of flux

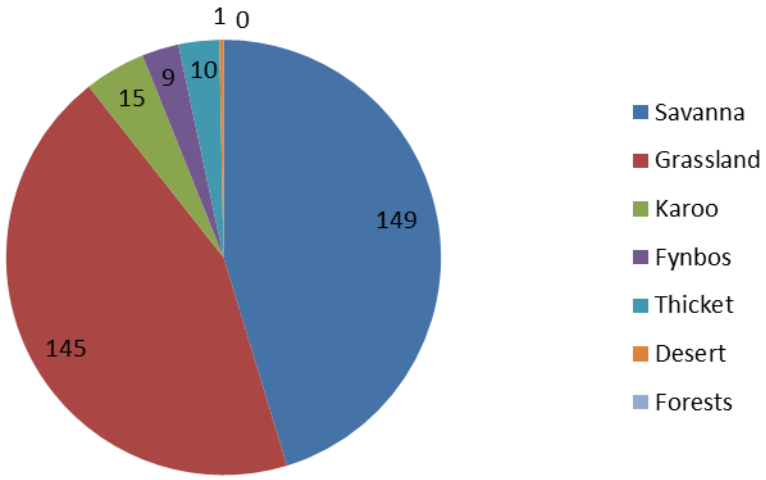


Gross Primary Production

Natural systems

Land cover class	Mean	SD spatial	Area	Best estimate	Lower confidence limit	Upper confidence limit
	$gC/m^2/y$		km^2		TgC/y	
Savanna	415	320	358473	149	54	351
Grassland	645	304	224377	145	72	361
Karoo	44	46	334812	15	5	34
Fynbos	142	134	61490	9	2	19
Thicket	381	264	27402	10	2	23
Desert	977	281	857	1	0	2
Forests	1	0	7017	0	0	0
Total, natural ecosystems			1014428	329	135	790

Fluxes from natural systems, TgC/y



Export fluxes:

In rivers 2.29

In crops – 1

In paper and pulp 0.4

In smoke 10

National GPP 1206 $TgCO_2$

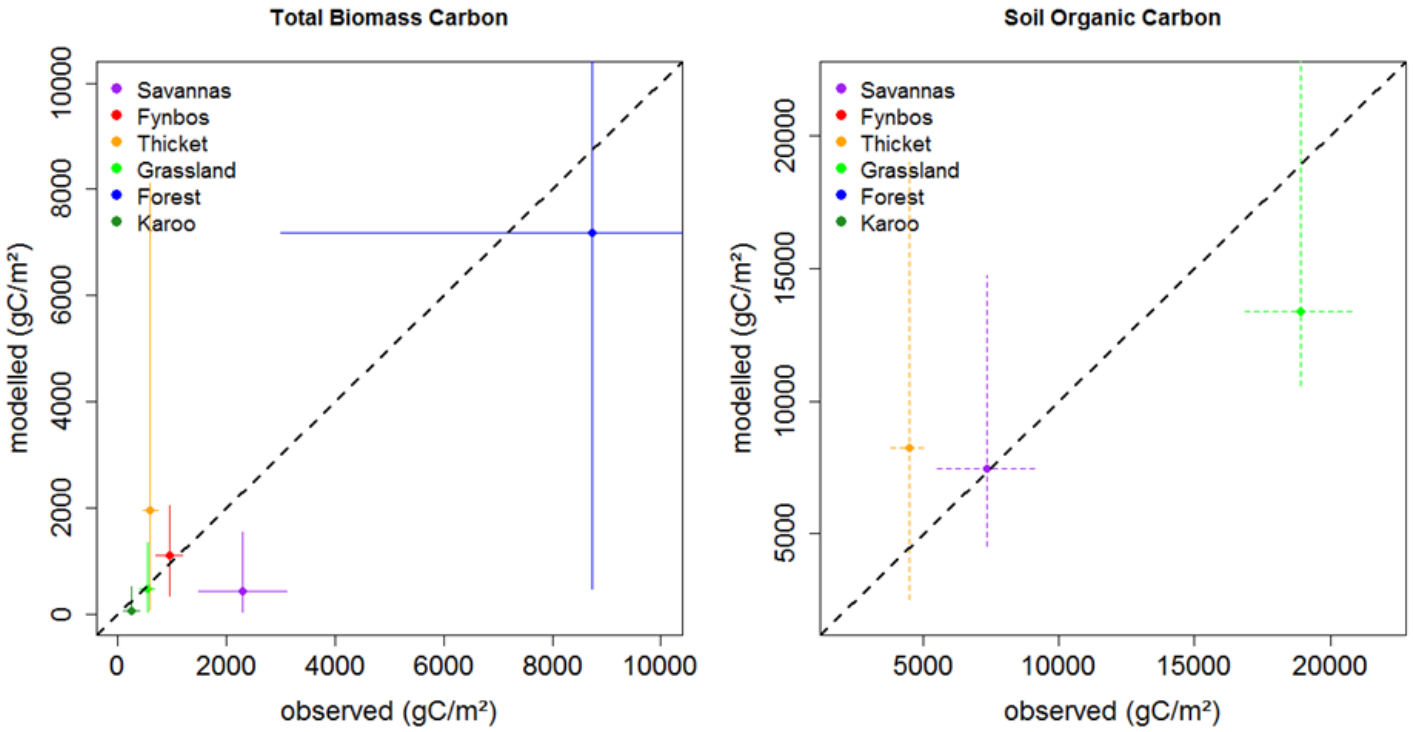
Net Ecosystem Production ~ 10-20 $TgCO_2$/y = national sink

For comparison: SA National inventory 2000 was 335 $TgCO_2$/y

Validation datasets

- Soil organic C: demanding requirements and cant use SA soil survey profiles n=200
  - Lesogo Khomo, 62 profiles in KNP
  - Mills &Cowling (Powell?), 119 profiles in thicket (intact, degated, old fields
  - Von Maltitz 19 profiles, Drakensberg
- Vegetation n=358
  - Savanna Shackleton 51 sites, Shea 12 sites (herbaceous and litter)
  - Fynbos 34 1980's studies; kruger, van Wilgen, Rutherford
  - Karoo 10 Middelberg, Tierberg, (others may be available)
  - Forest 41 Glenday eThekwini, Durheim S Cape, others pending
  - Grassland 72 Drakensberg, Bloemfontein, Kalahari
  - Thicket 150, Powell (used 1/3 for cal, 2/3 for val)

Validation


Total Biomass Carbon
Savannas
Fynbos
Thicket
Grassland
Forest
Karoo
modelled (gC/m²)
observed (gC/m²)
0
2000
4000
6000
8000
10000
Soil Organic Carbon
Savannas
Fynbos
Thicket
Grassland
Forest
Karoo
modelled (gC/m²)
observed (gC/m²)
5000
10000
15000
20000

Conclusions

- First-ever comprehensive estimate of the SA Carbon stock
  - 7170 TgC, of which 548 TgC as biomass
- High-resolution estimate, in time and space, of GPP and other fluxes
  - GPP ~ 329 TgC/y
- Will assist with GHG inventory reporting and strategic planning of land-based C mitigation strategy